

Application  
Number

SEARCH

IDS Flag Clearance for Application 10696995

IDS  
Information

| Content | Mailroom Date | Entry<br>Number | IDS<br>Review                       | Reviewer                           |
|---------|---------------|-----------------|-------------------------------------|------------------------------------|
| M844    | 02-18-2004    | 24              | <input checked="" type="checkbox"/> | 04-22-2004 11:01:03 adavid         |
| M844    | 01-23-2006    | 49              | <input checked="" type="checkbox"/> | 03-23-2006 13:27:51<br>BShrivastav |

UPDATE

## Refine Search

### Search Results -

| Term   | Documents |
|--|-----------|
| (9 AND 3).PGPB,USPT,USOC,EPAB,JPAB,DWPI,TDBD.    | 5         |
| (L9 AND L3 ).PGPB,USPT,USOC,EPAB,JPAB,DWPI,TDBD. | 5         |

Database:

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 EPO Abstracts Database  
 JPO Abstracts Database  
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 IBM Technical Disclosure Bulletins

Search:

L11

Refine Search

Recall Text

Clear

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### Search History

DATE: Thursday, March 23, 2006   [Printable Copy](#)   [Create Case](#)

**Set Name**   **Query**  
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*DB=PGPB,USPT,USOC,EPAB,JPAB,DWPI,TDBD; PLUR=YES; OP=ADJ*

|            |   |        |            |
|------------|---|--------|------------|
| <u>L11</u> | L9 and L3                                     | 5      | <u>L11</u> |
| <u>L10</u> | L9 and borehole                               | 1      | <u>L10</u> |
| <u>L9</u>  | L7 and (formation)                            | 21     | <u>L9</u>  |
| <u>L8</u>  | L7 and (earth adj formation)                  | 1      | <u>L8</u>  |
| <u>L7</u>  | L6 and L5                                     | 56     | <u>L7</u>  |
| <u>L6</u>  | L4 and hyperpolar\$4                          | 443    | <u>L6</u>  |
| <u>L5</u>  | L4 and (thermal adj equilibrium)              | 629    | <u>L5</u>  |
| <u>L4</u>  | L3 and (magnetic adj resonance) or NMR or MNI | 167572 | <u>L4</u>  |
| <u>L3</u>  | 324/300-322.ccls.                             | 8796   | <u>L3</u>  |
| <u>L2</u>  | 324/300-322                                   | 57     | <u>L2</u>  |
| <u>L1</u>  | 6958604                                       | 2      | <u>L1</u>  |

END OF SEARCH HISTORY

## Hit List

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Search Results - Record(s) 1 through 2 of 2 returned.

- ☐ 1. Document ID: US 6958604 B2, US 20040257075 A1, GB 2405939 A, DE 1004030276 A1, CN 1611965 A    Relevance Rank: 99

Using default format because multiple data bases are involved.

L1: Entry 2 of 2

File: DWPI

Oct 25, 2005

DERWENT-ACC-NO: 2005-057101

DERWENT-WEEK: 200570

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TITLE: Obtaining nuclear magnetic resonance measurements in wellbore used for characterizing formation fluids, by inducing static magnetic field, applying oscillating magnetic field, and acquiring nuclear magnetic resonance measurements

INVENTOR: AN, L; GANESAN, K ; SONG, Y

PRIORITY-DATA: 2003US-0601460 (June 23, 2003)

PATENT-FAMILY:

| PUB-NO                   | PUB-DATE          | LANGUAGE | PAGES | MAIN-IPC   |
|--------------------------|-------------------|----------|-------|------------|
| <u>US 6958604 B2</u>     | October 25, 2005  |          | 000   | G01V003/00 |
| <u>US 20040257075 A1</u> | December 23, 2004 |          | 021   | G01V003/00 |
| <u>GB 2405939 A</u>      | March 16, 2005    |          | 000   | G01V003/32 |
| <u>DE 1004030276 A1</u>  | May 12, 2005      |          | 000   | G01V003/32 |
| <u>CN 1611965 A</u>      | May 4, 2005       |          | 000   | G01V003/26 |

INT-CL (IPC): G01 R 33/30; G01 R 33/54; G01 V 3/00; G01 V 3/26; G01 V 3/32;  
G01 V 3/38

| Full | Title | Citation | Front | Review | Classification | Date | Reference | Claims | Pub | Draw |
|------|-------|----------|-------|--------|----------------|------|-----------|--------|-----|------|
|------|-------|----------|-------|--------|----------------|------|-----------|--------|-----|------|

- ☐ 2. Document ID: US 6958604 B2    Relevance Rank: 99

L1: Entry 1 of 2

File: USPT

Oct 25, 2005

US-PAT-NO: 6958604

DOCUMENT-IDENTIFIER: US 6958604 B2

TITLE: Apparatus and methods for J-edit nuclear magnetic resonance measurement

DATE-ISSUED: October 25, 2005

## INVENTOR-INFORMATION:

| NAME                   | CITY       | STATE | ZIP CODE | COUNTRY |
|------------------------|------------|-------|----------|---------|
| An; Li                 | Sugar Land | TX    |          |         |
| Song; Yi-Qiao          | Ridgefield | CT    |          |         |
| Ganesan; Krishnamurthy | Sugar Land | TX    |          |         |

## ASSIGNEE-INFORMATION:

| NAME                                | CITY       | STATE | ZIP CODE | COUNTRY | TYPE | CODE |
|-------------------------------------|------------|-------|----------|---------|------|------|
| Schlumberger Technology Corporation | Sugar Land | TX    |          |         | 02   |      |

APPL-NO: 10/601460 [PALM]

DATE FILED: June 23, 2003

INT-CL-ISSUED: [07] G01 V 3/00

US-CL-ISSUED: 324/303; 324/300

US-CL-CURRENT: 324/303; 324/300

FIELD-OF-CLASSIFICATION-SEARCH: 324/303, 324/300, 324/309, 324/307, 324/310, 436/173

See application file for complete search history.

## PRIOR-ART-DISCLOSED:

## U.S. PATENT DOCUMENTS

| PAT-NO         | ISSUE-DATE     | PATENTEE-NAME        | US-CL   |
|----------------|----------------|----------------------|---------|
| <u>5043664</u> | August 1991    | Kunz                 | 324/307 |
| <u>5317261</u> | May 1994       | Den Hollander et al. | 324/309 |
| <u>5629623</u> | May 1997       | Sezginer et al.      |         |
| <u>5914598</u> | June 1999      | Sezginer et al.      |         |
| <u>5955883</u> | September 1999 | Hennig               |         |
| <u>6104191</u> | August 2000    | Hurd                 | 324/310 |
| <u>6111408</u> | August 2000    | Blades et al.        | 324/303 |
| <u>6111409</u> | August 2000    | Edwards et al.       | 324/303 |
| <u>6140812</u> | October 2000   | Russell et al.       |         |
| <u>6147490</u> | November 2000  | Watanabe             | 324/307 |
| <u>6232778</u> | May 2001       | Speier et al.        |         |
| <u>6237404</u> | May 2001       | Crary et al.         |         |
| <u>6246236</u> | June 2001      | Poitzsch et al.      |         |
| <u>6255817</u> | July 2001      | Poitzsch et al.      |         |
| <u>6291995</u> | September 2001 | Speier et al.        |         |
| <u>6297632</u> | October 2001   | Speier               |         |
| <u>6326784</u> | December 2001  | Ganesan              |         |
| <u>6346813</u> | February 2002  | Kleinberg            |         |
| <u>6366089</u> | April 2002     | Poitzsch et al.      |         |
| <u>6373248</u> | April 2002     | Poitzsch et al.      |         |
| <u>6392410</u> | May 2002       | Luong et al.         |         |
| <u>6400149</u> | June 2002      | Luong et al.         |         |

|                     |                |                |         |
|---------------------|----------------|----------------|---------|
| <u>6472870</u>      | October 2002   | Bendall et al. | 324/307 |
| <u>6492809</u>      | December 2002  | Speier et al.  |         |
| <u>6518757</u>      | February 2003  | Speier         |         |
| <u>6518758</u>      | February 2003  | Speier et al.  |         |
| <u>6528995</u>      | March 2003     | Speier et al.  |         |
| <u>6531869</u>      | March 2003     | Speier et al.  |         |
| <u>6538438</u>      | March 2003     | Speier et al.  |         |
| <u>6566874</u>      | May 2003       | Speier et al.  |         |
| <u>6570381</u>      | May 2003       | Speier et al.  |         |
| <u>6617169</u>      | September 2003 | Ke et al.      | 436/173 |
| <u>2002/0075000</u> | June 2002      | Prammer et al. |         |

## FOREIGN PATENT DOCUMENTS

| FOREIGN-PAT-NO | PUBN-DATE     | COUNTRY | CLASS |
|----------------|---------------|---------|-------|
| 0 514 978      | November 1992 | EP      |       |
| 1 098 204      | May 2001      | EP      |       |
| 2 396 016      | June 2004     | GB      |       |

## OTHER PUBLICATIONS

EL Hahn & DE Maxwell, "Spin Echo Measurements of Nuclear Spin Coupling in Molecules," Physical Rev. 88, No. 5, pp. 1070-1084 (1952).

L Muller, A Kumar & RR Ernst, "Two-dimensional Carbon-13 NMR Spectroscopy," J. Phys. Chem. 63, pp. 5490-5491 (1975).

FD Doty, RR Inners & PD Ellis, "A Multinuclear Double-Tuned Probe for Applications with Solids or Liquids utilizing Lumped Tuning Elements," J. Magnetic Res. 43, pp. 399-416 (1981).

MH Levitt, "Symmetrical Composite Pulse Sequences for NMR Population Inversion," J. Magnetic Res. 48, pp. 234-264 (1982).

MH Leavitt & R Freeman, "NMR Population Inversion using a Composite Pulse," J. Magnetic Res. 33, pp. 473-476 (1979).

SR Hartmann & EL Hahn, "Nuclear Double Resonance in the Rotating Frame," Phys. Rev. 128, No. 5, pp. 2042-2053 (1962).

GA Morris & R Freeman, "Enhancement of Nuclear Magnetic Resonance Signals by Polarization Transfer," J. Am. Chem. Soc. 101, No. 3, pp. 760-762 (1970).

LA Davis et al., "The Modulation of Coupled Relaxation in Porous Media," Magnetic Resonance Imaging 19 (pp. 369-373 (2001).

TJ Norwood et al., "Measurement of the Scalar Coupling and Transverse Relaxation Times of Doublets," Journal of Magnetic Resonance Series A 101, pp. 109-112 (1993).

ART-UNIT: 2859

PRIMARY-EXAMINER: Shrivastav; Brij B.

ATTY-AGENT-FIRM: McEnaney; Kevin P. Echols; Brigitte L. Segura; Victor H.

## ABSTRACT:

A method for obtaining nuclear magnetic resonance measurements includes inducing a static magnetic field in a formation fluid sample; applying an oscillating magnetic

field to the fluid sample according to a preparation pulse sequence that comprises a J-edit pulse sequence for developing J modulation; and acquiring the nuclear magnetic resonance measurements using a detection sequence, wherein the detection sequence comprises at least one 180-degree pulse. The method may further include acquiring the nuclear magnetic resonance measurements a plurality of times each with a different value in a variable delay in the J-edit pulse sequence; and analyzing amplitudes of the plurality of nuclear magnetic resonance measurements as a function of the variable delay to provide J coupling information.

30 Claims, 14 Drawing figures

| Full | Title | Citation | Front | Review | Classification | Date | Reference |  |  | Claims | KWIC | Draw D. |
|------|-------|----------|-------|--------|----------------|------|-----------|--|--|--------|------|---------|
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|-------|---------------------|-------|----------|-----------|---------------|

| Term   | Documents |
|--|-----------|
| "6958604"                                      | 2         |
| 6958604S                                       | 0         |
| "6958604".PGPB,USPT,USOC,EPAB,JPAB,DWPI,TDBD.  | 2         |
| (6958604 ).PGPB,USPT,USOC,EPAB,JPAB,DWPI,TDBD. | 2         |

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Search Results - Record(s) 1 through 5 of 5 returned.

- ☐ 1. Document ID: US 20040119471 A1      Relevance Rank: 58

Using default format because multiple data bases are involved.

L11: Entry 2 of 5

File: PGPB

Jun 24, 2004

PGPUB-DOCUMENT-NUMBER: 20040119471

PGPUB-FILING-TYPE: new

DOCUMENT-IDENTIFIER: US 20040119471 A1

TITLE: Downhole high resolution NMR spectroscopy with polarization enhancement

PUBLICATION-DATE: June 24, 2004

INVENTOR-INFORMATION:

| NAME           | CITY       | STATE | COUNTRY |
|----------------|------------|-------|---------|
| Blanz, Martin  | Celle      |       | DE      |
| Kruspe, Thomas | Wienhausen |       | DE      |

US-CL-CURRENT: 324/303

| Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | Claims | Keywords | Drawings |
|------|-------|----------|-------|--------|----------------|------|-----------|-----------|-------------|--------|----------|----------|
|------|-------|----------|-------|--------|----------------|------|-----------|-----------|-------------|--------|----------|----------|

- ☐ 2. Document ID: US 5789921 A      Relevance Rank: 50

L11: Entry 5 of 5

File: USPT

Aug 4, 1998

US-PAT-NO: 5789921

DOCUMENT-IDENTIFIER: US 5789921 A

**\*\* See image for Certificate of Correction \*\***

TITLE: Magnetic resonance imaging using hyperpolarized noble gases

DATE-ISSUED: August 4, 1998

INVENTOR-INFORMATION:

| NAME                  | CITY     | STATE | ZIP CODE | COUNTRY |
|-----------------------|----------|-------|----------|---------|
| Albert; Mitchell S.   | Shoreham | NY    |          |         |
| Balamore; Dilip       | Shoreham | NY    |          |         |
| Cates, Jr.; Gordon D. | Skillman | NJ    |          |         |
| Driehuys; Bastiaan    | Bristol  | PA    |          |         |

|                 |           |    |
|-----------------|-----------|----|
| Happer; William | Princeton | NJ |
| Saam; Brian     | Princeton | NJ |
| Wishnia; Arnold | Setauket  | NY |

## ASSIGNEE-INFORMATION:

| NAME  | CITY      | STATE | ZIP | CODE | COUNTRY | TYPE | CODE |
|---|-----------|-------|-----|------|---------|------|------|
| The Research Foundation of State University of New York | Alabnay   | NY    |     |      |         | 02   |      |
| The Trustees of Princeton University                    | Princeton | NJ    |     |      |         | 02   |      |

APPL-NO: 08/485356 [PALM]  
 DATE FILED: June 7, 1995

## PARENT-CASE:

This is a divisional of application Ser. No. 08/225,243 filed on Ap. 8, 1995, now U.S. Pat. No. 5,545,396.

INT-CL-ISSUED: [06] G01 V 3/00

US-CL-ISSUED: 324/300; 324/304, 128/653.4

US-CL-CURRENT: 324/300; 324/304, 600/420

FIELD-OF-CLASSIFICATION-SEARCH: 324/300, 324/304, 324/312, 324/307, 324/309, 128/653.4, 128/654

See application file for complete search history.

## PRIOR-ART-DISCLOSED:

## U.S. PATENT DOCUMENTS

| PAT-NO         | ISSUE-DATE    | PATENTEE-NAME  | US-CL      |
|----------------|---------------|----------------|------------|
| <u>4450407</u> | May 1984      | Kwon et al.    | 324/304    |
| <u>4586511</u> | May 1986      | Clark, Jr.     | 128/653    |
| <u>4775522</u> | October 1988  | Clark, Jr.     | 424/9      |
| <u>4793357</u> | December 1988 | Lindstrom      | 128/654    |
| <u>4862359</u> | August 1989   | Trivedi et al. | 364/413.05 |
| <u>4996041</u> | February 1991 | Arai et al.    | 424/9      |
| <u>5357959</u> | October 1994  | Fishman        | 128/653.4  |
| <u>5433196</u> | July 1995     | Fiat           | 128/653.4  |

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Albert et al., *Chem. Abstracts* 121:128933r (1994).  
Pfeffer, M., *Chem. Abstracts* 121:174319 (1994).

ART-UNIT: 225

PRIMARY-EXAMINER: Arana; Louis M.

ATTY-AGENT-FIRM: Hoffmann & Baron

#### ABSTRACT:

A method of imaging a spatial distribution of a noble gas by nuclear magnetic resonance spectrometry includes detecting a spatial distribution of at least one noble gas by NMR spectrometry and generating a representation of said spatial distribution of the noble gas. The noble gas is selected from noble gas isotopes having nuclear spin, preferably Xenon-129 and/or Helium-3. The noble gas is at least thermally or equilibrium polarized and is preferably hyperpolarized, most preferably hyperpolarized by optical (laser) pumping in the presence of an alkali metal or by metastability exchange. The generation of the representation of the noble gas spatial distribution includes at least one dimension, preferably 2 or 3 dimensions of the spatial distribution. The noble gas may be imaged according to the invention in chemical or biological systems, preferably in a human or animal subject or organ system or tissue thereof. Also, apparatus for nuclear magnetic resonance imaging of the spatial distribution of at least one noble gas includes means for imaging a noble gas by NMR spectrometry and means for providing and/or storing imageable quantities of a noble gas, preferably hyperpolarized Xenon-129 and/or Helium-3. Also, a medical composition includes a medically acceptable bifunctional gas effective for in vivo anesthesiological and NMR imaging functions,

including at least one noble gas, preferably hyperpolarized Xenon-129 and/or Helium-3.

9 Claims, 19 Drawing figures

| Full | Title | Citation | Front | Review | Classification | Date | Reference |  |  | Claims | FIG | Draw |
|------|-------|----------|-------|--------|----------------|------|-----------|--|--|--------|-----|------|
|------|-------|----------|-------|--------|----------------|------|-----------|--|--|--------|-----|------|

☐ 3. Document ID: US 20050200356 A1      Relevance Rank: 48

L11: Entry 1 of 5

File: PGPB

Sep 15, 2005

PGPUB-DOCUMENT-NUMBER: 20050200356

PGPUB-FILING-TYPE: new

DOCUMENT-IDENTIFIER: US 20050200356 A1

TITLE: Method for measuring the nuclear magnetic resonance (NMR) of substances having hyperpolarized nuclei using continuously refocused multiecho spectroscopic imaging

PUBLICATION-DATE: September 15, 2005

INVENTOR-INFORMATION:

| NAME            | CITY     | STATE | COUNTRY |
|-----------------|----------|-------|---------|
| Hennig, Juergen | Freiburg |       | DE      |

APPL-NO: 11/076554      [PALM]

DATE FILED: March 9, 2005

FOREIGN-APPL-PRIORITY-DATA:

| COUNTRY | APPL-NO           | DOC-ID                   | APPL-DATE      |
|---------|-------------------|--------------------------|----------------|
| DE      | 10 2004 011 874.4 | 2004DE-10 2004 011 874.4 | March 11, 2004 |

INT-CL-PUBLISHED: [07] G01 V 3/00

US-CL-PUBLISHED: 324/307; 324/309, 324/310

US-CL-CURRENT: 324/307; 324/309, 324/310

REPRESENTATIVE-FIGURES: 4

ABSTRACT:

A nuclear magnetic resonance (NMR) method for spatially resolved measurement of the distribution of signals of metabolites of different resonance frequencies by application of a sequence of radio-frequency pulses and switched magnetic fields, wherein the generated signals are generated by application of read gradients in a spatially encoded manner in the direction of these gradients, is characterized in that, after a time interval  $TR/2$ , the initially excited magnetization is subjected to a sequence of several radio frequency pulses, which are equally spaced by time intervals  $TR$ , and the used magnetic field gradients in each  $TR$  interval are applied such that the originally excited magnetization is repeatedly refocused in several

TR intervals and thereby read out several times, several signals are generated within one TR interval by multiple inversion of the read gradient, and the signals which are read-out several times are each identically spatially encoded by application of phase encoding gradients and therefore differ only with respect to dephasing given by the respective resonance frequency, such that the individual signals at any read-out time can subsequently be associated with the signal contributions of the examined substances of different resonance frequencies. This method permits chemical shift selective measurement of hyperpolarized metabolites.

| Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | Claims | AMC | Draw U. |
|------|-------|----------|-------|--------|----------------|------|-----------|-----------|-------------|--------|-----|---------|
|------|-------|----------|-------|--------|----------------|------|-----------|-----------|-------------|--------|-----|---------|

☐ 4. Document ID: US 6453188 B1      Relevance Rank: 42

L11: Entry 4 of 5

File: USPT

Sep 17, 2002

US-PAT-NO: 6453188

DOCUMENT-IDENTIFIER: US 6453188 B1

TITLE: Method of magnetic resonance imaging

DATE-ISSUED: September 17, 2002

INVENTOR-INFORMATION:

| NAME                          | CITY   | STATE | ZIP CODE | COUNTRY |
|-------------------------------|--------|-------|----------|---------|
| Ardenkjaer-Larsen; Jan Henrik | Malmo  |       |          | SE      |
| Axelsson; Oskar               | Malmo  |       |          | SE      |
| Golman; Klaes                 | Malmo  |       |          | SE      |
| Hansson; Georg                | Malmo  |       |          | SE      |
| Leunbach; Ib                  | Dragor |       |          | DK      |
| Petersson; Stefan             | Malmo  |       |          | SE      |
| Wistrand; Lars-Goran          | Malmo  |       |          | SE      |

ASSIGNEE-INFORMATION:

| NAME               | CITY | STATE | ZIP CODE | COUNTRY | TYPE CODE |
|--------------------|------|-------|----------|---------|-----------|
| Amersham Health AS | Oslo |       |          | NO      | 03        |

APPL-NO: 09/333910      [PALM]

DATE FILED: June 16, 1999

PARENT-CASE:

This application is a continuation of pending international application number PCT/GB98/00021 filed Jan. 5, 1998 (of which the entire disclosure of the pending, prior application is hereby incorporated by reference), which itself is a continuation-in-part of U.S. provisional application No. 60/066,573 filed Nov. 26, 1997; benefit of which is claimed under 35 U.S.C. 119(e).

FOREIGN-APPL-PRIORITY-DATA:

| COUNTRY | APPL-NO | APPL-DATE         |
|---------|---------|-------------------|
| GB      | 9700256 | January 8, 1997   |
| GB      | 9724590 | November 20, 1997 |

GB

9725364

November 28, 1997

INT-CL-ISSUED: [07] A61 B 5/05

US-CL-ISSUED: 600/420; 424/9.3, 324/307, 324/309

US-CL-CURRENT: 600/420; 324/307, 324/309, 424/9.3

FIELD-OF-CLASSIFICATION-SEARCH: 600/420, 600/410, 324/307, 324/309, 424/9.3

See application file for complete search history.

PRIOR-ART-DISCLOSED:

## U.S. PATENT DOCUMENTS

| PAT-NO         | ISSUE-DATE  | PATENTEE-NAME            | US-CL   |
|----------------|-------------|--------------------------|---------|
| <u>5617859</u> | April 1997  | Souza et al.             | 600/420 |
| <u>5785953</u> | July 1998   | Albert et al.            | 424/9.3 |
| <u>H1968</u>   | June 2001   | Bernstein                | 600/410 |
| <u>6278893</u> | August 2001 | Ardenkjaer-Larson et al. | 600/420 |

## FOREIGN PATENT DOCUMENTS

| FOREIGN-PAT-NO | PUBN-DATE    | COUNTRY | CLASS |
|----------------|--------------|---------|-------|
| WO 95 27438    | October 1995 | WO      |       |
| WO 95/27438    | October 1995 | WO      |       |

## OTHER PUBLICATIONS

XP 002034982, MR Imaging with Hyperpolarized .sup.3 He Gas, Hunter Middleton, Robert D. Black, Brian Saam, Gordon D. Cates, Gary P. Cofer, Robert Guenther, William Happer, Lawrence W. Hedlund, G. Alan Johnson, Kim Juvan, John Swartz, MRM 33:271-275 (1995).

XP 000304183, The Use of Dynamically Polarized Contrast Agents, 2244 Research Disclosure (1993) Apr., No. 348, Emsworth, GB.

"The use of dynamically polarized contrast agents", Research Disclosure, No. 348, 1993, p. XP000304183, see whole document.

H. Middleton et al., "Mr. Imaging with Hyperpolarized 3He Gas", Magnetic Resonance In Medicine, vol. 33, 1995, pp. 271-275, XP002034982, see whole document.

ART-UNIT: 3737

PRIMARY-EXAMINER: Casler; Brian L.

ATTY-AGENT-FIRM: Bacon &amp; Thomas

## ABSTRACT:

The invention relates to a method of magnetic imaging (MR) of a living sample comprising the steps of hyperpolarizing a hyperpolarizable gas ex-vivo and transferring the nuclear polarization from the hyperpolarized gas to the nuclei of an MR imaging agent, that is not hyperpolarizable, that is exposed to a uniform magnetic field and that is introduced in contact to the hyperpolarizable gas,

separating the hyperpolarizable gas from the MR imaging agent, administering the MR imaging agent to the living sample, exciting NMR transitions in the nuclei of the imaging agent and detecting an NMR signal thereof.

12 Claims, 8 Drawing figures

| Full | Title | Citation | Front | Review | Classification | Date | Reference |  |  | Claims | IMC | Draw. P. |
|------|-------|----------|-------|--------|----------------|------|-----------|--|--|--------|-----|----------|
|------|-------|----------|-------|--------|----------------|------|-----------|--|--|--------|-----|----------|

☐ 5. Document ID: US 6574495 B1 Relevance Rank: 30

L11: Entry 3 of 5

File: USPT

Jun 3, 2003

US-PAT-NO: 6574495

DOCUMENT-IDENTIFIER: US 6574495 B1

TITLE: Para-hydrogen labelled agents and their use in magnetic resonance imaging

DATE-ISSUED: June 3, 2003

INVENTOR-INFORMATION:

| NAME                | CITY  | STATE | ZIP CODE | COUNTRY |
|---------------------|-------|-------|----------|---------|
| Golman; Klaes       | Malmo |       |          | SE      |
| Axelsson; Oskar     | Malmo |       |          | SE      |
| Johannesson; Haukur | Malmo |       |          | SE      |
| Olofsson; Charlotte | Malmo |       |          | SE      |
| Mansson; Sven       | Malmo |       |          | SE      |
| Petersson; Stefan   | Malmo |       |          | SE      |

ASSIGNEE-INFORMATION:

| NAME               | CITY | STATE | ZIP CODE | COUNTRY | TYPE CODE |
|--------------------|------|-------|----------|---------|-----------|
| Amersham Health AS | Oslo |       |          | NO      | 03        |

APPL-NO: 09/565450 [PALM]

DATE FILED: May 5, 2000

PARENT-CASE:

This application is a continuation of pending international application number PCT/GB98/03399 filed Nov. 12, 1998 (of which the entire disclosure of the pending, prior application is hereby incorporated by reference), which itself is a continuation-in-part of U.S. provisional applications Nos. 60/066,570, filed Nov. 26, 1997; and 60/076,924, filed Mar. 5, 1998.

FOREIGN-APPL-PRIORITY-DATA:

| COUNTRY | APPL-NO | APPL-DATE         |
|---------|---------|-------------------|
| GB      | 9723920 | November 12, 1997 |
| GB      | 9800158 | January 5, 1998   |

INT-CL-ISSUED: [07] A61 B 5/05

US-CL-ISSUED: 600/420; 600/407, 600/410, 324/307, 324/309, 424/9.3

US-CL-CURRENT: 600/420; 324/307, 324/309, 424/9.3, 600/407, 600/410

FIELD-OF-CLASSIFICATION-SEARCH: 600/407, 600/410, 600/420, 324/307, 324/309, 424/9.3

See application file for complete search history.

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

| PAT-NO         | ISSUE-DATE    | PATENTEE-NAME | US-CL   |
|----------------|---------------|---------------|---------|
| <u>5700448</u> | December 1997 | Golman et al. | 424/9.3 |

FOREIGN PATENT DOCUMENTS

| FOREIGN-PAT-NO | PUBN-DATE   | COUNTRY | CLASS |
|----------------|-------------|---------|-------|
| 0 665 282      | August 1995 | WO      |       |

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Casanova et al., "phenylacetylene-1-13C", Organic Preparations and Procedures, 1969, XP002094734.

Baldwin et al., "Synthesis of chiral isoxazolidin-5-ones and their applications to the synthesis of beta-amino-alanines and beta-(N-hydroxyamino)-alanines", Tetrahedron, 1994, XP002094735.

Jordan et al., "Mechanistic and stereochemical investigation of fatty acid and polyketide biosynthesis using chiral malonates", Tetrahedron, 1991, XP002094736.

Bottomley P.A. et al., "Proton-decoupled, Overhauser-enhanced, Spatially Localized Carbon-13 Spectroscopy in Humans\*", Magnetic Resonance in Medicine, Dec. 1, 1989, XP000102293.

Barkemeyer et al., "Hetero-NMR enhancement via parahydrogen", J. Am. Chem. Soc., 1995, XP002094737.

"Ortho- and Parahydrogen: Spin Isomers of Molecular Hydrogen" <http://www.thch.uni-bonn.de/pc/bargon/PHIP/parahydrogen.html> Feb. 5, 2002.\*

Golman et al. "Parahydrogen-Induced Polarization in Imaging: Subsecond 13 C Angiography" Magnetic Resonance in Medicine 46:1-5 (2001).\*

Koch et al. "Examination of Subsequent Reaction Products Enhanced Through Parahydrogen-Induced Nuclear Polarization (PHIP)" Magnetic Resonance in Chemistry 2000; vol. 38: p. 216-220.

ART-UNIT: 3737

PRIMARY-EXAMINER: Lateef; Marvin M.

ASSISTANT-EXAMINER: Lin; Jeoyuh

ATTY-AGENT-FIRM: Bacon & Thomas

ABSTRACT:

The invention provides a method of magnetic resonance investigation of a sample, said method comprising: (i) reacting para-hydrogen enriched hydrogen with a hydrogenatable MR imaging agent precursor containing a non-hydrogen non-zero

nuclear spin nucleus to produce a hydrogenated MR imaging agent; (ii) administering said hydrogenated MR imaging agent to said sample; (iii) exposing said sample to radiation of a frequency selected to excite nuclear spin transitions of said non-zero nuclear spin nucleus in said hydrogenated MR imaging agent; (v) detecting magnetic resonance signals of said non-zero nuclear spin nucleus from said sample; and (vi) optionally, generating an image or biological functional data or dynamic flow data from said detected signals.

22 Claims, 17 Drawing figures

| Full | Title | Citation | Front | Review | Classification | Date | Reference |  |  | Claims | KWD | Draw. D. |
|------|-------|----------|-------|--------|----------------|------|-----------|--|--|--------|-----|----------|
|------|-------|----------|-------|--------|----------------|------|-----------|--|--|--------|-----|----------|

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| Term   | Documents |
|--|-----------|
| (9 AND 3) .PGPB, USPT, USOC, EPAB, JPAB, DWPI, TDBD.       | 5         |
| (L9 AND<br>L3 ) .PGPB, USPT, USOC, EPAB, JPAB, DWPI, TDBD. | 5         |

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- ☐ 1. Document ID: US 20040119471 A1      Relevance Rank: 58

Using default format because multiple data bases are involved.

L11: Entry 2 of 5

File: PGPB

Jun 24, 2004

PGPUB-DOCUMENT-NUMBER: 20040119471

PGPUB-FILING-TYPE: new

DOCUMENT-IDENTIFIER: US 20040119471 A1

TITLE: Downhole high resolution NMR spectroscopy with polarization enhancement

PUBLICATION-DATE: June 24, 2004

INVENTOR-INFORMATION:

| NAME           | CITY       | STATE | COUNTRY |
|----------------|------------|-------|---------|
| Blanz, Martin  | Celle      |       | DE      |
| Kruspe, Thomas | Wienhausen |       | DE      |

US-CL-CURRENT: 324/303

| Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | Claims | Keywords | Drawings |
|------|-------|----------|-------|--------|----------------|------|-----------|-----------|-------------|--------|----------|----------|
|------|-------|----------|-------|--------|----------------|------|-----------|-----------|-------------|--------|----------|----------|

- ☐ 2. Document ID: US 5789921 A      Relevance Rank: 50

L11: Entry 5 of 5

File: USPT

Aug 4, 1998

US-PAT-NO: 5789921

DOCUMENT-IDENTIFIER: US 5789921 A

**\*\* See image for Certificate of Correction \*\***

TITLE: Magnetic resonance imaging using hyperpolarized noble gases

DATE-ISSUED: August 4, 1998

INVENTOR-INFORMATION:

| NAME                  | CITY     | STATE | ZIP CODE | COUNTRY |
|-----------------------|----------|-------|----------|---------|
| Albert; Mitchell S.   | Shoreham | NY    |          |         |
| Balamore; Dilip       | Shoreham | NY    |          |         |
| Cates, Jr.; Gordon D. | Skillman | NJ    |          |         |
| Driehuys; Bastiaan    | Bristol  | PA    |          |         |

|                 |           |    |
|-----------------|-----------|----|
| Happer; William | Princeton | NJ |
| Saam; Brian     | Princeton | NJ |
| Wishnia; Arnold | Setauket  | NY |

## ASSIGNEE-INFORMATION:

| NAME  | CITY      | STATE | ZIP | CODE | COUNTRY | TYPE | CODE |
|---|-----------|-------|-----|------|---------|------|------|
| The Research Foundation of State University of New York | Alabnay   | NY    |     |      |         | 02   |      |
| The Trustees of Princeton University                    | Princeton | NJ    |     |      |         | 02   |      |

APPL-NO: 08/485356 [PALM]  
 DATE FILED: June 7, 1995

## PARENT-CASE:

This is a divisional of application Ser. No. 08/225,243 filed on Ap. 8, 1995, now U.S. Pat. No. 5,545,396.

INT-CL-ISSUED: [06] G01 V 3/00

US-CL-ISSUED: 324/300; 324/304, 128/653.4

US-CL-CURRENT: 324/300; 324/304, 600/420

FIELD-OF-CLASSIFICATION-SEARCH: 324/300, 324/304, 324/312, 324/307, 324/309, 128/653.4, 128/654

See application file for complete search history.

## PRIOR-ART-DISCLOSED:

## U.S. PATENT DOCUMENTS

| PAT-NO         | ISSUE-DATE    | PATENTEE-NAME  | US-CL      |
|----------------|---------------|----------------|------------|
| <u>4450407</u> | May 1984      | Kwon et al.    | 324/304    |
| <u>4586511</u> | May 1986      | Clark, Jr.     | 128/653    |
| <u>4775522</u> | October 1988  | Clark, Jr.     | 424/9      |
| <u>4793357</u> | December 1988 | Lindstrom      | 128/654    |
| <u>4862359</u> | August 1989   | Trivedi et al. | 364/413.05 |
| <u>4996041</u> | February 1991 | Arai et al.    | 424/9      |
| <u>5357959</u> | October 1994  | Fishman        | 128/653.4  |
| <u>5433196</u> | July 1995     | Fiat           | 128/653.4  |

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ART-UNIT: 225

PRIMARY-EXAMINER: Arana; Louis M.

ATTY-AGENT-FIRM: Hoffmann & Baron

#### ABSTRACT:

A method of imaging a spatial distribution of a noble gas by nuclear magnetic resonance spectrometry includes detecting a spatial distribution of at least one noble gas by NMR spectrometry and generating a representation of said spatial distribution of the noble gas. The noble gas is selected from noble gas isotopes having nuclear spin, preferably Xenon-129 and/or Helium-3. The noble gas is at least thermally or equilibrium polarized and is preferably hyperpolarized, most preferably hyperpolarized by optical (laser) pumping in the presence of an alkali metal or by metastability exchange. The generation of the representation of the noble gas spatial distribution includes at least one dimension, preferably 2 or 3 dimensions of the spatial distribution. The noble gas may be imaged according to the invention in chemical or biological systems, preferably in a human or animal subject or organ system or tissue thereof. Also, apparatus for nuclear magnetic resonance imaging of the spatial distribution of at least one noble gas includes means for imaging a noble gas by NMR spectrometry and means for providing and/or storing imageable quantities of a noble gas, preferably hyperpolarized Xenon-129 and/or Helium-3. Also, a medical composition includes a medically acceptable bifunctional gas effective for in vivo anesthesiological and NMR imaging functions,

including at least one noble gas, preferably hyperpolarized Xenon-129 and/or Helium-3.

9 Claims, 19 Drawing figures

| Full | Title | Citation | Front | Review | Classification | Date | Reference |  |  | Claims | NMR | Draw U |
|------|-------|----------|-------|--------|----------------|------|-----------|--|--|--------|-----|--------|
|------|-------|----------|-------|--------|----------------|------|-----------|--|--|--------|-----|--------|

☐ 3. Document ID: US 20050200356 A1      Relevance Rank: 48

L11: Entry 1 of 5

File: PGPB

Sep 15, 2005

PGPUB-DOCUMENT-NUMBER: 20050200356

PGPUB-FILING-TYPE: new

DOCUMENT-IDENTIFIER: US 20050200356 A1

TITLE: Method for measuring the nuclear magnetic resonance (NMR) of substances having hyperpolarized nuclei using continuously refocused multiecho spectroscopic imaging

PUBLICATION-DATE: September 15, 2005

INVENTOR-INFORMATION:

| NAME            | CITY     | STATE | COUNTRY |
|-----------------|----------|-------|---------|
| Hennig, Juergen | Freiburg |       | DE      |

APPL-NO: 11/076554      [PALM]

DATE FILED: March 9, 2005

FOREIGN-APPL-PRIORITY-DATA:

| COUNTRY | APPL-NO           | DOC-ID                   | APPL-DATE      |
|---------|-------------------|--------------------------|----------------|
| DE      | 10 2004 011 874.4 | 2004DE-10 2004 011 874.4 | March 11, 2004 |

INT-CL-PUBLISHED: [07] G01 V 3/00

US-CL-PUBLISHED: 324/307; 324/309, 324/310

US-CL-CURRENT: 324/307; 324/309, 324/310

REPRESENTATIVE-FIGURES: 4

ABSTRACT:

A nuclear magnetic resonance (NMR) method for spatially resolved measurement of the distribution of signals of metabolites of different resonance frequencies by application of a sequence of radio-frequency pulses and switched magnetic fields, wherein the generated signals are generated by application of read gradients in a spatially encoded manner in the direction of these gradients, is characterized in that, after a time interval  $TR/2$ , the initially excited magnetization is subjected to a sequence of several radio frequency pulses, which are equally spaced by time intervals  $TR$ , and the used magnetic field gradients in each  $TR$  interval are applied such that the originally excited magnetization is repeatedly refocused in several

TR intervals and thereby read out several times, several signals are generated within one TR interval by multiple inversion of the read gradient, and the signals which are read-out several times are each identically spatially encoded by application of phase encoding gradients and therefore differ only with respect to dephasing given by the respective resonance frequency, such that the individual signals at any read-out time can subsequently be associated with the signal contributions of the examined substances of different resonance frequencies. This method permits chemical shift selective measurement of hyperpolarized metabolites.

| Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | Claims | Abstract | Drawings |
|------|-------|----------|-------|--------|----------------|------|-----------|-----------|-------------|--------|----------|----------|
|------|-------|----------|-------|--------|----------------|------|-----------|-----------|-------------|--------|----------|----------|

☐ 4. Document ID: US 6453188 B1      Relevance Rank: 42

L11: Entry 4 of 5

File: USPT

Sep 17, 2002

US-PAT-NO: 6453188

DOCUMENT-IDENTIFIER: US 6453188 B1

TITLE: Method of magnetic resonance imaging

DATE-ISSUED: September 17, 2002

INVENTOR-INFORMATION:

| NAME                          | CITY   | STATE | ZIP CODE | COUNTRY |
|-------------------------------|--------|-------|----------|---------|
| Ardenkjaer-Larsen; Jan Henrik | Malmo  |       |          | SE      |
| Axelsson; Oskar               | Malmo  |       |          | SE      |
| Golman; Klaes                 | Malmo  |       |          | SE      |
| Hansson; Georg                | Malmo  |       |          | SE      |
| Leunbach; Ib                  | Dragor |       |          | DK      |
| Petersson; Stefan             | Malmo  |       |          | SE      |
| Wistrand; Lars-Goran          | Malmo  |       |          | SE      |

ASSIGNEE-INFORMATION:

| NAME               | CITY | STATE | ZIP CODE | COUNTRY | TYPE CODE |
|--------------------|------|-------|----------|---------|-----------|
| Amersham Health AS | Oslo |       |          | NO      | 03        |

APPL-NO: 09/333910      [PALM]

DATE FILED: June 16, 1999

PARENT-CASE:

This application is a continuation of pending international application number PCT/GB98/00021 filed Jan. 5, 1998 (of which the entire disclosure of the pending, prior application is hereby incorporated by reference), which itself is a continuation-in-part of U.S. provisional application No. 60/066,573 filed Nov. 26, 1997; benefit of which is claimed under 35 U.S.C. 119(e).

FOREIGN-APPL-PRIORITY-DATA:

| COUNTRY | APPL-NO | APPL-DATE         |
|---------|---------|-------------------|
| GB      | 9700256 | January 8, 1997   |
| GB      | 9724590 | November 20, 1997 |

GB

9725364

November 28, 1997

INT-CL-ISSUED: [07] A61 B 5/05

US-CL-ISSUED: 600/420; 424/9.3, 324/307, 324/309

US-CL-CURRENT: 600/420; 324/307, 324/309, 424/9.3

FIELD-OF-CLASSIFICATION-SEARCH: 600/420, 600/410, 324/307, 324/309, 424/9.3

See application file for complete search history.

PRIOR-ART-DISCLOSED:

## U.S. PATENT DOCUMENTS

| PAT-NO         | ISSUE-DATE  | PATENTEE-NAME            | US-CL   |
|----------------|-------------|--------------------------|---------|
| <u>5617859</u> | April 1997  | Souza et al.             | 600/420 |
| <u>5785953</u> | July 1998   | Albert et al.            | 424/9.3 |
| <u>H1968</u>   | June 2001   | Bernstein                | 600/410 |
| <u>6278893</u> | August 2001 | Ardenkjaer-Larson et al. | 600/420 |

## FOREIGN PATENT DOCUMENTS

| FOREIGN-PAT-NO | PUBN-DATE    | COUNTRY | CLASS |
|----------------|--------------|---------|-------|
| WO 95 27438    | October 1995 | WO      |       |
| WO 95/27438    | October 1995 | WO      |       |

## OTHER PUBLICATIONS

XP 002034982, MR Imaging with Hyperpolarized .sup.3 He Gas, Hunter Middleton, Robert D. Black, Brian Saam, Gordon D. Cates, Gary P. Cofer, Robert Guenther, William Happer, Lawrence W. Hedlund, G. Alan Johnson, Kim Juvan, John Swartz, MRM 33:271-275 (1995).

XP 000304183, The Use of Dynamically Polarized Contrast Agents, 2244 Research Disclosure (1993) Apr., No. 348, Emsworth, GB.

"The use of dynamically polarized contrast agents", Research Disclosure, No. 348, 1993, p. XP000304183, see whole document.

H. Middleton et al., "Mr. Imaging with Hyperpolarized 3He Gas", Magnetic Resonance In Medicine, vol. 33, 1995, pp. 271-275, XP002034982, see whole document.

ART-UNIT: 3737

PRIMARY-EXAMINER: Casler; Brian L.

ATTY-AGENT-FIRM: Bacon &amp; Thomas

## ABSTRACT:

The invention relates to a method of magnetic imaging (MR) of a living sample comprising the steps of hyperpolarizing a hyperpolarizable gas ex-vivo and transferring the nuclear polarization from the hyperpolarized gas to the nuclei of an MR imaging agent, that is not hyperpolarizable, that is exposed to a uniform magnetic field and that is introduced in contact to the hyperpolarizable gas,

separating the hyperpolarizable gas from the MR imaging agent, administering the MR imaging agent to the living sample, exciting NMR transitions in the nuclei of the imaging agent and detecting an NMR signal thereof..

12 Claims, 8 Drawing figures

| Full | Title | Citation | Front | Review | Classification | Date | Reference |  |  | Claims | FIG | Draw |
|------|-------|----------|-------|--------|----------------|------|-----------|--|--|--------|-----|------|
|------|-------|----------|-------|--------|----------------|------|-----------|--|--|--------|-----|------|

☐ 5. Document ID: US 6574495 B1 Relevance Rank: 30

L11: Entry 3 of 5

File: USPT

Jun 3, 2003

US-PAT-NO: 6574495

DOCUMENT-IDENTIFIER: US 6574495 B1

TITLE: Para-hydrogen labelled agents and their use in magnetic resonance imaging

DATE-ISSUED: June 3, 2003

INVENTOR-INFORMATION:

| NAME                | CITY  | STATE | ZIP CODE | COUNTRY |
|---------------------|-------|-------|----------|---------|
| Golman; Klaes       | Malmo |       |          | SE      |
| Axelsson; Oskar     | Malmo |       |          | SE      |
| Johannesson; Haukur | Malmo |       |          | SE      |
| Olofsson; Charlotte | Malmo |       |          | SE      |
| Mansson; Sven       | Malmo |       |          | SE      |
| Petersson; Stefan   | Malmo |       |          | SE      |

ASSIGNEE-INFORMATION:

| NAME               | CITY | STATE | ZIP CODE | COUNTRY | TYPE CODE |
|--------------------|------|-------|----------|---------|-----------|
| Amersham Health AS | Oslo |       |          | NO      | 03        |

APPL-NO: 09/565450 [PALM]

DATE FILED: May 5, 2000

PARENT-CASE:

This application is a continuation of pending international application number PCT/GB98/03399 filed Nov. 12, 1998 (of which the entire disclosure of the pending, prior application is hereby incorporated by reference), which itself is a continuation-in-part of U.S. provisional applications Nos. 60/066,570, filed Nov. 26, 1997; and 60/076,924, filed Mar. 5, 1998.

FOREIGN-APPL-PRIORITY-DATA:

| COUNTRY | APPL-NO | APPL-DATE         |
|---------|---------|-------------------|
| GB      | 9723920 | November 12, 1997 |
| GB      | 9800158 | January 5, 1998   |

INT-CL-ISSUED: [07] A61 B 5/05

US-CL-ISSUED: 600/420; 600/407, 600/410, 324/307, 324/309, 424/9.3



US-CL-CURRENT: 600/420; 324/307, 324/309, 424/9.3, 600/407, 600/410

FIELD-OF-CLASSIFICATION-SEARCH: 600/407, 600/410, 600/420, 324/307, 324/309, 424/9.3

See application file for complete search history.

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

| PAT-NO         | ISSUE-DATE    | PATENTEE-NAME | US-CL   |
|----------------|---------------|---------------|---------|
| <u>5700448</u> | December 1997 | Golman et al. | 424/9.3 |

FOREIGN PATENT DOCUMENTS

| FOREIGN-PAT-NO | PUBN-DATE   | COUNTRY | CLASS |
|----------------|-------------|---------|-------|
| 0 665 282      | August 1995 | WO      |       |

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Casanova et al., "phenylacetylene-1-13C", Organic Preparations and Procedures, 1969, XP002094734.

Baldwin et al., "Synthesis of chiral isoxazolidin-5-ones and their applications to the synthesis of beta-amino-alanines and beta-(N-hydroxyamino)-alanines", Tetrahedron, 1994, XP002094735.

Jordan et al., "Mechanistic and stereochemical investigation of fatty acid and polyketide biosynthesis using chiral malonates", Tetrahedron, 1991, XP002094736.

Bottomley P.A. et al., "Proton-decoupled, Overhauser-enhanced, Spatially Localized Carbon-13 Spectroscopy in Humans\*", Magnetic Resonance in Medicine, Dec. 1, 1989, XP000102293.

Barkemeyer et al., "Hetero-NMR enhancement via parahydrogen", J. Am. Chem. Soc., 1995, XP002094737.

"Ortho- and Parahydrogen: Spin Isomers of Molecular Hydrogen" <http://www.thch.uni-bonn.de/pc/bargon/PHIP/parahydrogen.html> Feb. 5, 2002.\*

Golman et al. "Parahydrogen-Induced Polarization in Imaging: Subsecond 13 C Angiography" Magnetic Resonance in Medicine 46:1-5 (2001).\*

Koch et al. "Examination of Subsequent Reaction Products Enhanced Through Parahydrogen-Induced Nuclear Polarization (PHIP)" Magnetic Resonance in Chemistry 2000; vol. 38: p. 216-220.

ART-UNIT: 3737

PRIMARY-EXAMINER: Lateef; Marvin M.

ASSISTANT-EXAMINER: Lin; Jeoyuh

ATTY-AGENT-FIRM: Bacon & Thomas

ABSTRACT:

The invention provides a method of magnetic resonance investigation of a sample, said method comprising: (i) reacting para-hydrogen enriched hydrogen with a hydrogenatable MR imaging agent precursor containing a non-hydrogen non-zero

nuclear spin nucleus to produce a hydrogenated MR imaging agent; (ii) administering said hydrogenated MR imaging agent to said sample; (iii) exposing said sample to radiation of a frequency selected to excite nuclear spin transitions of said non-zero nuclear spin nucleus in said hydrogenated MR imaging agent; (v) detecting magnetic resonance signals of said non-zero nuclear spin nucleus from said sample; and (vi) optionally, generating an image or biological functional data or dynamic flow data from said detected signals.

22 Claims, 17 Drawing figures

| Full | Title | Citation | Front | Review | Classification | Date | Reference | Claims | KMC | Draw D. |
|------|-------|----------|-------|--------|----------------|------|-----------|--------|-----|---------|
|------|-------|----------|-------|--------|----------------|------|-----------|--------|-----|---------|

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| Term  | Documents |
|---|-----------|
| (9 AND 3) .PGPB, USPT, USOC, EPAB, JPAB, DWPI, TBD.       | 5         |
| (L9 AND<br>L3 ) .PGPB, USPT, USOC, EPAB, JPAB, DWPI, TBD. | 5         |

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